

it moves to the position shown in Figure 26C, it is in communication with the orifice 314. Again, the piston is at its minimum rate of axial movement as it passes the top-dead center and the continued displacement of fluid can be accommodated within the chamber 68a. At the position shown in Figure 26D, the piston has gone past top-dead center and is being moved towards bottom-dead center. In this position however, it is not in communication with the low pressure kidney port 300 and the residual pressure within the chamber 68a replenishes the fluid within the cylinder to avoid cavitation. As the barrel continues to rotate, the cylinder is put into communication with the low pressure port and the fluid is drawn into the cylinder.

[0087] It will be seen therefore that as the barrel 40a rotates, the pistons are alternatively connected to pressure and suction ports 302, 300 and that the spacing of the ports is such as to inhibit leakage between the high pressure and low pressure chambers. The provision of the restricted orifice 314 together with the balancing chamber 68a accommodates the small change in volume as the pistons go over bottom-dead center or top-dead center as well as providing a balancing force to maintain the port plate against the end of the barrel 40a. The undercut 310 provides a relatively unrestricted ingress of fluid into the cylinders to enhance the efficiency of the machine and inhibit cavitation.

#### **CLAIMS:**

1. A hydraulic machine comprising a housing, a rotating group rotatably mounted within said housing and including barrel and a plurality of pistons axially slideable in said cylinders in said barrel, and a swashplate assembly to engage said pistons and induce reciprocation thereof as said barrel rotates in said housing, a port plate interposed between said barrel and said housing and effective to connect respective ones of said cylinders alternatively with an inlet port and an outlet port, and a slipper assembly acting between said swashplate and said piston to transfer loads therebetween, said slipper assembly including a base having a planar bearing surface engagable with said swashplate and a spherical bearing engagable with a part spherical recess in said piston.
2. A machine according to claim 1 wherein said piston is tubular and said slipper assembly includes a passageway extending through said base from said piston to said planar bearing to supply fluid thereto.

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3. A machine according to 2 wherein said base of slipper assembly has a diameter greater than that of said piston and said slippers are retained in engagement with said swashplate by a plate having a plurality of apertures each of which receives a respective one of said pistons and has a marginal portion overlying a respective one of said bases.
4. A machine according to claim 3 wherein said swashplate includes an annular insert providing a planar face over which said slipper assemblies may slide.
5. A slipper assembly for a piston assembly of a rotary hydraulic machine, said slipper assembly comprising a base having a planar bearing surface disposed on one side for engagement with a swashplate and a spherical bearing disposed on an oppositely directed side for engagement with a part spherical recess in said piston.
6. A slipper assembly according to claim 5 wherein a passageway extends through said spherical bearing and said base.
7. A slipper assembly according to claim 6 wherein said base includes a spigot projecting from said oppositely directed side and said spherical bearing is received on said spigot.
8. A slipper assembly according to claim 7 wherein said spherical bearing has a through bore to receive said spigot and a counterbore to permit enlargement of said spigot to retain said spherical bearing on said spigot.
9. A slipper assembly according to claim 7 wherein said passageway extends through said spigot.
10. A piston assembly for a rotating hydraulic machine comprising a piston having a spherical recess at one end thereof and a slipper assembly including a base having planar bearing surface on one side and a spherical bearing on an oppositely directed side thereof, said spherical bearing being located within said spherical recess to provide limited pivotal movement between said piston and slipper assembly.
11. A piston assembly according to claim 10 wherein said spherical recess has a depth greater than the radius of said spherical bearing and walls of said recess extend beyond an equator of said spherical bearing and conform thereto to secure said spherical bearing in said recess.
12. A piston assembly according to claim 11 wherein a spigot extends from said oppositely directed side of said base and said spherical bearing is secured to said spigot.

13. A piston assembly according to claim 12 wherein said spherical bearing has a through bore to receive said spigot and a counterbore to permit enlargement of said spigot to retain said spherical bearing on said spigot.
14. A piston assembly according to claim 12 wherein said piston is tubular.
15. A piston assembly according to claim 14 wherein a passageway extends through said base to permit hydraulic fluid to flow from an interior of said piston to said planar bearing surface.
16. A method of forming a piston assembly for a rotary hydraulic machine comprising the steps of forming a part spherical cavity in one end of a piston to an axial depth greater than the diameter of said cavity, inserting therein a complementary spherical bearing of a slipper assembly, and deforming the walls of said cavity to conform to the surface of said spherical bearing.
17. A method according to claim 16 wherein said step of deforming said walls includes the step of applying a radial load about the equator of said spherical bearing after said walls conform to said surface.
18. A method according to claim 17 including the step of inserting a spigot of a base into a bore formed in said spherical bearing and securing said spigot by radially expanding said spigot in said bore.

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